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SHORTER ARTICLES AND DISCUSSION

PINK-EYED WHITE MICE, CARRYING THE COLOR FACTOR

AMONG the many domesticated varieties of the house mouse (*Mus musculus*), two sorts with entirely white pelage are known,—the albino, and the black-eyed white. Numerous experiments have shown that the albino differs from colored varieties by the loss of a single factor, the color factor; for, in crosses with colored varieties, albinism acts as a recessive allelomorph. The genetic composition of the black-eyed white is less well known although several hypotheses have been suggested. Black-eyed whites possess the color factor as crosses with albinos have shown. They may be homozygous in the factor for dark eyes. A black-eyed white male produced 189 dark-eyed offspring in my experiments when mated to pink-eyed intense brown females. The offspring of this cross were heterozygous in dark eye (Dd). By mating them inter se, pink-eyed forms were obtained in the F_2 generation, some of which had a pure white coat. In other words, it is possible to recombine the factors producing the pure white pelage of the black-eyed whites with the pink-eyed condition. Such pink-eyed whites resemble true albinos in appearance, but not in zygotic constitution, for they still retain the color factor although they show no color. To avoid confusion in discussion, I shall refer to this synthesized form of albino as a pink-eyed white to distinguish it from the albino lacking the color factor. Predictions often compel subsequent retractions; however, I feel safe in predicting colored offspring from a cross between the pink-eyed white and the albino, although externally the mating resembles a cross between albinos which always breed true. Black-eyed white strains sometimes show a few colored hairs around the ears, between the eyes, and in front of the tail. The corresponding pink-eyed white forms may also show the same characteristic.

The white coat and pink eyes of the albino mouse are due to the loss of a single factor; but the white coat of the black-eyed white strains cannot be accounted for in such a simple manner. Little ('13) seemed inclined to the view that the black-eyed white mouse was a spotted individual in which the spotting was of the

recessive type, in contradistinction to spotting of the dominant type described by Miss Durham ('08). Through the kindness of Professor W. E. Castle, a black-eyed white male was received in the fall of 1914. With this male it was possible to produce other black-eyed whites. In such black-eyed whites as I have been able to test, both dominant and recessive spotting were present. Furthermore, the recessive spotting always occurred in double dose. Hence, black-eyed whites were supposed to have the zygotic formula PPss or Ppss, in which P stands for dominant spotting and p for its absence; and s represents the factor for recessive spotting which is allelomorphic to self (S). So far, I have been able to test sufficiently only two black-eyed white males, both of which were clearly of the formula Ppss. When mated to self-colored females they gave 231 offspring. Since these offspring showed much variability, they were graded in classes ranging from self (—9) to black-eyed white (+9) according to the amount of pigmentation which they showed. A distinct grouping around two modes was found as follows:

Class modes..	—9	—8	—7	—6	—5	—4	—3	—2	—1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9
Frequencies..	98	24	8	16	33	26	8	4	6	2	3	1	1	1	0	0	0	0	0

About one-half of the F_1 offspring was grouped around the lower mode (126), and the other half (105) grouped around the upper mode, if we assume the class —7, as the dividing class. Very few individuals were found in the "doubtful class." Expressing the cross of black-eyed white with self-colored in Mendelian terms, it would be:

$$\begin{array}{l}
 Ppss \times ppSS = P_1 \text{ zygotes} \\
 \begin{array}{ll}
 Ps + & ps = \text{gametes of black-eyed white } P_1 \\
 pS + & pS = \text{gametes of self-colored } P_1
 \end{array} \\
 \hline
 PpSs + ppSs = F_1 \text{ zygotes} \\
 \text{Spotted} + \text{Self}
 \end{array}$$

The results conformed to this expectation. The individuals grouped around the lower mode were self-colored or very nearly so, as one would expect of individuals heterozygous in self and recessive spotting, for self is dominant or very nearly dominant to recessive spotting. Their formula was ppSs. Subsequent experiments corroborated this, for they produced self and recessive spotted in Mendelian ratios, when mated inter se or to recessive spotted individuals. They never gave black-eyed whites in

such matings. Those offspring grouped around the upper mode were spotted, and had a formula PpSs. When mated inter se or back to recessive spotted, they gave, besides spotted and selfs, black-eyed whites; apparently because the combination Ppss could again be formed. The dominant spotting factor, P, evidently acts more vigorously upon recessive spotting than upon self. It can not restrict the more extended pigmentation of a self coat completely. Hence, half of the F₁ individuals (those with the formula PpSs) were spotted, or, to describe them more accurately, spotted with frequent and varying amounts of silvering. The dominant spotting factor, P, can, however, restrict the limited pigmentation of a recessive spotted coat completely or almost completely. Hence animals with the formula Ppss were black-eyed whites.

The origin of our new pink-eyed white forms, which resemble albinos so closely as to be indistinguishable from them, is evidently due to the substitution of the pink-eye factor for dark-eye in black-eyed whites, and not due to the loss of the color factor C. In our cultures, the black-eyed whites have the formula PpssDDCC and the corresponding pink-eyed whites had the formula PpssddCC where D and d represent dark eye and pink eye respectively, and C represents the color factor. We have also produced black-eyed white forms heterozygous in dark eye, PpssDd. Black and brown are likewise interchangeable in the dark-eyed whites, for black-eyed whites, heterozygous in black, have been produced. I see no reason why brown-eyed whites can not be produced in the usual Mendelian fashion by mating black-eyed whites to browns, and recovering the white pelage with brown eyes in the F₂ generation. Mating the spotted F₁ offspring inter se should give, among others, individuals with the formula PpssbbCC. These would be brown-eyed whites,—white because of the combined action of P and s, and brown simply because they lack the differential factor B which changes brown into black.

The occurrence of pink-eyed whites which resemble albinos may have some bearing on an anomalous case cited by Bateson ('04) as follows: "the production of colored animals by albinos, is not, so far as I know, illustrated by a single case, with the following exception. In the later editions of "Fancy Mice" (Upcott Gill), Dr. Carter Blake, formerly secretary of the Anthropological Institute commenting on the statement that albino mice of whatever

parentage produce nothing but albinos, writes that a pair of albinos produced some brown-and-white, some plum, some grey, and some albinos. If this result occurred under all precautions, it stands alone." Allen ('04) attempted to account for this case by postulating an error in recording the true sire, or that the animals used were not true albinos but black-eyed whites. That two individuals having white coats and pink eyes can give colored young is perfectly possible. The pink-eyed whites in my cultures have a white pelage because of the combined effect of the dominant and recessive spotting, while their pink eye is due to the loss of the dark-eye factor. They still retain the color factor, although they show no color. They may be called albinos, if we define an albino as any pink-eyed white individual; but they should be carefully distinguished from that type of albinism which is due to the loss of the color factor. If we mate these two different types of albinos together, we should obtain colored young. The cross may be expressed in symbols:

$$\begin{array}{rcl}
 PpssddCC \times ppSSDDcc & \dots\dots\dots & P. \text{ zygotes} \\
 PsdC + \quad psdC & \dots\dots\dots & \text{gametes of pink-eyed white} \\
 pSDe + \quad pSDe & \dots\dots\dots & \text{gametes of albino} \\
 \hline
 PpSsDdCc + ppSsDdCc & \dots\dots\dots & F_1 \text{ zygotes} \\
 \text{Spotted} + \text{Selfs} & &
 \end{array}$$

It is interesting to note that the exceptional case, quoted by Bateson, mentions the occurrence of spotted and selfs in the cross of two albinos. In plants, as in animals, similar somatic characters do not necessarily indicate similar germinal constitution.

Our assumption of the interaction of a dominant and recessive spotting factor to account for the white pelage of pink-eyed and black-eyed whites is strengthened by the valuable paper of Little ('15). Little has adopted a similar hypothesis for black-eyed whites in his paper just published, and quite different from the hypothesis of his earlier paper ('13). It should be stated that Little's experiments furnish even a larger amount of data from the more convincing type of matings than has been possible in our own cultures as yet.

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REFERENCES

- Allen, G. M. 1904. *Proc. Am. Acad. Arts and Sci.*, vol. 40, pp. 61-163.
 Bateson, W. 1903. *Proc. Zool. Soc. London*, vol. 2, pp. 71-98.
 Durham, F. M. 1908. *Royal Soc., Rep. Evol. Comm.*, No. 4, pp. 41-53.
 Little, C. C. 1913. *Carnegie Inst. Wash., Pub.* 179, pp. 11-102.
 Little, C. C. 1915. *Am. Nat.*, vol. 49, pp. 727-740.